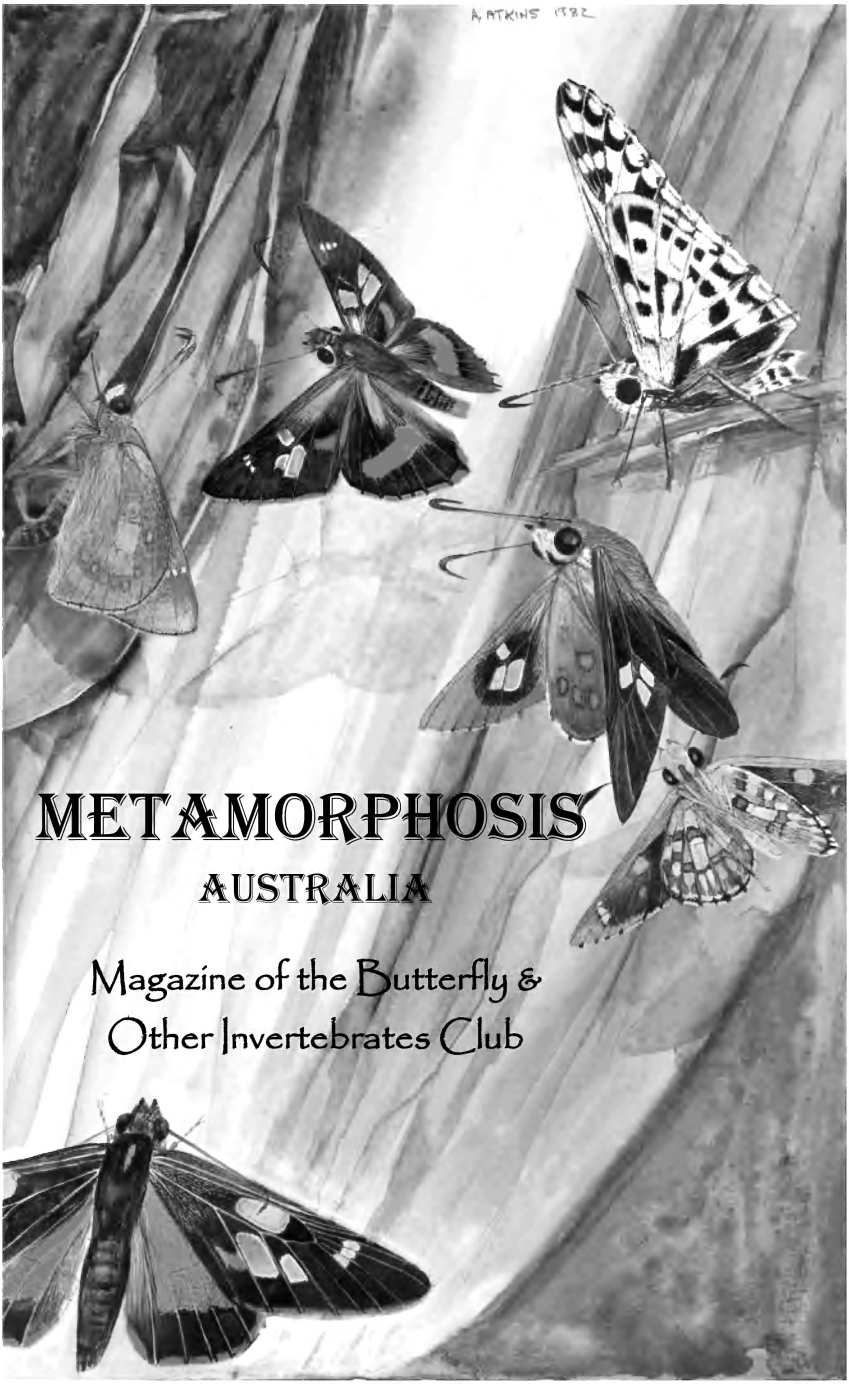

METAMORPHOSIS

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PLANNING AND ORGANIZATION MEETINGS

A quarterly meeting is scheduled in order to plan club activities and the magazine. See BOIC Programme.

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PO Box 2113, Runcorn, Queensland 4113
Membership fees are $30 for individuals, schools, and organizations.

AIMS OF THE ORGANIZATION

- To establish a network of people growing butterfly host plants;
- To hold information meetings about invertebrates;
- To organize excursions around the theme of invertebrates e.g. butterflies, native bees, ants, dragonflies, beetles, freshwater habitats, and others;
- To promote the conservation of the invertebrate habitat;
- To promote the keeping of invertebrates as alternative pets;
- To promote research into invertebrates;
- To encourage the construction of invertebrate friendly habitats in urban areas.

MAGAZINE DEADLINES

If you wish to submit an item for publication the following deadlines apply:
March issue – February 1st June issue – May 1st
September issue – August 1st December issue – November 1st
All articles should be submitted directly to the Editor daphne.bowden1@bigpond.com

COVER PAINTING

Skipper butterflies (Trapezitinae) from the SE Australian forests: top centre *Trapezites praxedes;* top right *Hesperilla ornata;* middle left *Toxidia andersoni*; middle right *Mesodina halyzia;* below this *Anisynta tillyardi*; bottom left *Hesperilla idothea*
Painting by Andrew Atkins

FROM THE PRESIDENT

As a six-year-old boy seventy-four years ago, Andrew Atkins first developed an interest in nature, art and drawing in his native England. After graduating from art school in Victoria, he worked in Australian television for several years before returning to England where he worked as a freelance artist. It was while working at the British Museum for three years that Andrew really began to focus on the skipper family of butterflies. On returning to Australia he worked as an illustrator for the CSIRO for some time before beginning an eighteen-year stint as a lecturer at Newcastle University teaching Fine Art and Scientific Illustration. Andrew has read extensively, written quite a number of papers and visited many countries in his study of skippers. Regarded by many as a leading authority, Andrew jokes that it was not difficult to be rated thus as only a handful of people were foolhardy enough to take on the challenge. I know you will appreciate the depth of his knowledge and the beauty of his illustrations.

We are grateful to all those whose generous contributions make this our 86th edition an interesting, colourful and informative read. Thank you for sharing your interest with us.

At our general meeting on August 12th last, Lois Hughes was presented with a framed photograph of her favourite butterfly – the Ulysses Butterfly – together with a scroll awarding her life membership of the club. This was in recognition of her 22 years of cheerful support, the production of many drawings and beautiful paintings and her very readable articles. We wish her well for the future.

Best wishes, *Ross*

IN THIS ISSUE

Skipper butterflies (Hesperoidea) and bar codes: how old are they, and how do the Aussie species fit in to the scheme of things? (Part one: the sub-family Trapezitinae and their ilk) – *Andrew Atkins*

Introduction

Formal, Latinized nomenclature (taxonomic description) of life forms has always been about unambiguous language communication. By expressing in any way possible, the similarity or difference between one or another species, or groups of organisms in a logical and comprehensive way, a formal order and ranking can be achieved. This systematic format can reveal the species' relationship (that is their connectivity) in structure, biology and evolution. But grouping and naming the biota may not always be entirely possible when there is a lack of fully researched information, or the number of species is large. Evolution can be a complex and mysterious three-dimensional (quantum?) process where the pathway of variation is marked by a multi-directional system of change and adaption.

Much of the world's biota is yet to be discovered, let alone formally named. Each species is a product of evolution – the change that the organism has undergone through time and as a result of geological or climatic events that occurred in the past, and of course, its in-born genetic diversity. Each taxon has its own history to be written: and somebody needs to do it.

Skipper butterflies (Hesperiidae) are a wonderful example of subtle but complex evolutionary change. Initially there seems to be a stasis of form and function throughout the 4-5000 or so described species (nearly a quarter of all butterflies) found throughout the world (except New Zealand or the polar regions). Many species seem (dare I say it!) a bit dull and unobtrusive, very quick, and devilishly hard to see. The 'father' of skipper systematics, W.H. Evans, said it all "*They are difficult to see and catch: difficult to kill and set: difficult to identify and classify. Few are of economic interest and most are small and drab. Nevertheless their serious study presents an endless number of baffling, though fascinating, problems to anyone gifted – or cursed – with an enquiring type of mind and with plenty of the patience and time needed for the purpose"*. Few 'cursed' researchers would disagree with this observation, though there are some remarkably beautiful species to study, especially in the tropics. Many people who can recognise them (they are mostly hairy and fat-bodied and have hooked antennae) see skippers as moths, and they are not far from the truth.

If you have an enquiring mind and want to know all about these creatures, there is a ton of information yet to be uncovered about skippers, that is, their morphology, their distribution and origin, and how the adult and juvenile skippers interact with their habitats (life history): they are a somewhat 'under-done' group of butterflies! Just

where did they come from and how are all the various groups (genera and sub-families etc.) interconnected across the world?

Present systematic alignment describes the order Papilionidea (which includes all butterflies that contains seven families, one of which includes skipper butterflies (Hesperiidae)), which in turn is divided into seven subfamilies. In this study I deal mostly with the genera of the Australasian subfamily Trapezitinae and compare them, using the time-honored (!) morphological method, with relevant genera in the subfamilies Heteropterinae and Hesperiinae which have a telltale distribution around the world.

Methodology

In this article (Part 1) I have focused my research on my favorite Australian group, the trapezitines (I call them 'Southern Deltas'), and include colour illustrations of link-groups of genera, and some black and white diagrams that include a family tree as I see it. This survey is mostly on comparative local and some continental genera (Appendix A). The methodology is traditional morphological (structural) components, utilizing adult and juvenile material as a comparative model to recent advanced molecular studies based in America.

A previous preliminary discussion paper on skippers, published as notes/summary of a talk given for the Entomological Society of Queensland in 2005 (*Atkins, *News Bulletin* **33**[2]: 24-34), provided a generalised position on the phylogeny of these butterflies. This was in anticipation of a comprehensive combined molecular (DNA sequencing) and morphological study of the world's genera by Andy Warren *et al*., published in 2008 and 2009.

The world of skippers

Essentially skippers (family Hesperiidae) can be sorted into two natural groups; the Pyrginae with larvae that feed on dicotyledon plants, and Hesperiinae with larvae that feed on monocotyledon plants. The adults of the first group usually settle with wings spread apart, the second group mostly settle with wings upright or hind wings flatter like paper darts. For those readers who are unfamiliar with skippers, you always need to get close and look for those bent antennal clubs. You will often find them nectaring on flowers in sunny patches of your garden. These will belong to four subfamilies, two of which occur further afield into the northern hemisphere.

The Trapezitinae are something special, because it is the only subfamily of skippers restricted to Australasia. My research, lasting many years, indicates that it is a reasonably ancestral group of butterflies with possible links to South America via Gondwana. The New Guinea trapezitine genera are of special interest in this regard.

The Trapezitinae: a history

Waterhouse and Lyell (1932) established the subfamily Trapezitinae, characterized by "Forewings held erect when resting: often with a discal sexmark (dark, raised scales) above in male… Hindwing with vein 5 (M_2) absent… forewing with vein 5 (M_2) straight at base". The descriptions included 10 Australian genera and 51 species.

Plate 1

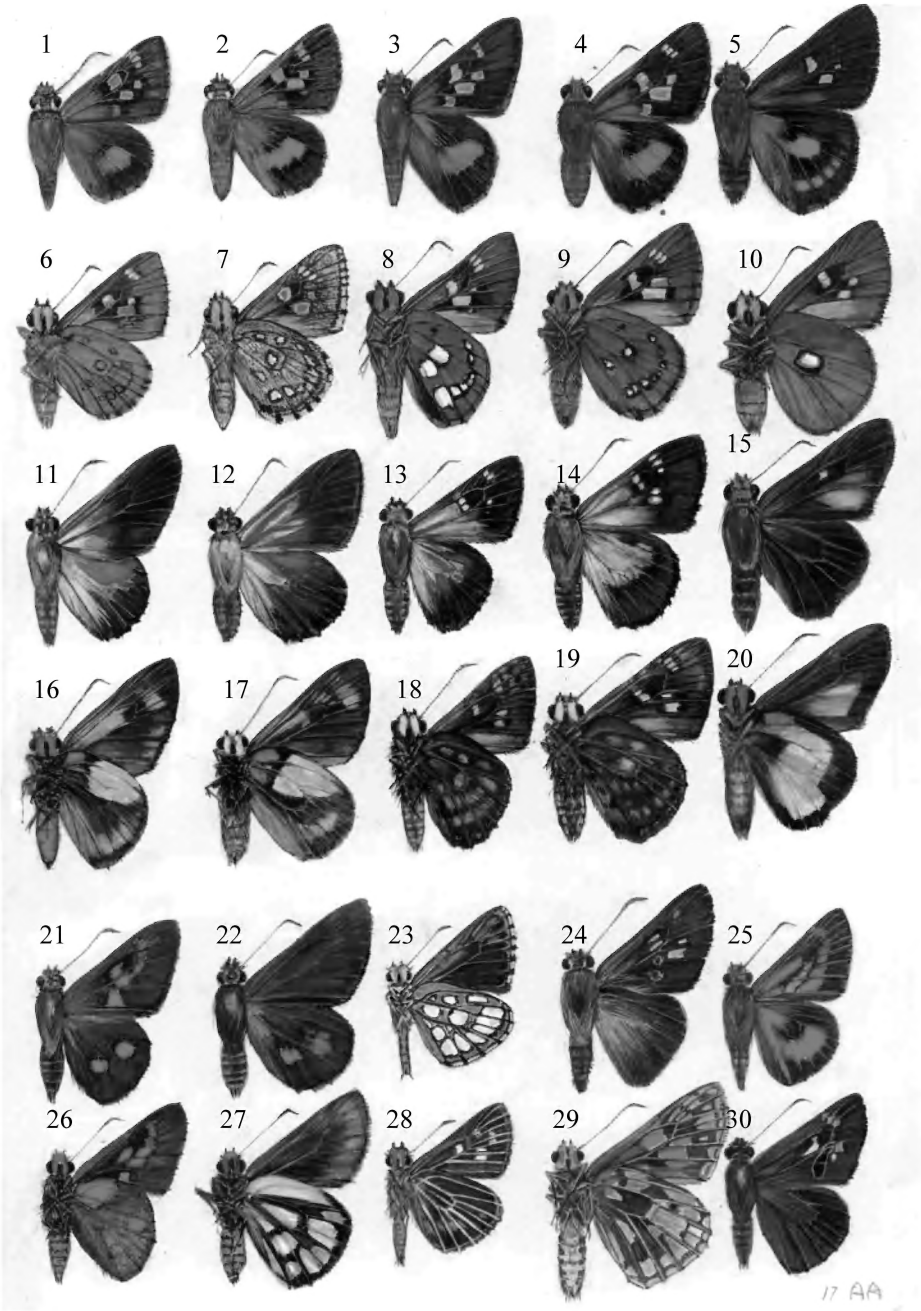
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PLATE 1 (all Trapezitinae, except where marked (HESP) = Hesperiinae, or (HET) = Heteropterinae.

(1) *Trapezites phigalia*, male upperside (VIC); (2) *T. phigalia*, female upperside (VIC); (3) *T. genevieveae*, male upperside (NSW); (4) *T. genevieveae* female upperside (NSW); (5) *Malaza carmides*, female upperside (Madagascar) (HESP?); (6) *T. phigalia*, female underside (VIC); (7) *T. waterhousei*, female underside (WA); (8) *T. genevieveae*, male underside (NSW); (9) *T. genevieveae*, female underside (NSW); (10) *Malaza carmides*, female underside (Madagascar) (HESP?); (11) *Prada rothschildi*, male upperside (PNG); (12) *P. rothschildi* female upperside (PNG); (13) *Rachelia extrusa,* male upperside (PNG); (14) *R. extrusa,* female upperside (PNG); (15) *Tiacellia tiacellia*, male upperside (PNG); (16) *Prada rothschildi*, male underside (PNG); (17) *P. rothschildi* female underside (PNG); (18) *Rachelia extrusa*, male underside (PNG); (19) *R. extrusa*, female underside (PNG); (20) *Tiacellia tiacellia*, male underside (PNG); (21) *Prada papua*, male upperside (PNG); (22) *P. papua*, female upperside (PNG); (23) *Heteropterus morpheus*, male underside (France) (HET); (24) *Pithauria marsena*, male upperside (Malasia) (HESP); (25) *Telicota ancilla*, male upperside (NSW); (26) *Prada papua*, male underside (PNG); (27) *P. papua*, female underside (PNG); (28) *Herimosa albovenata*, male underside (SA); (29) *Hesperilla mastersi*, female underside (NSW); (30) *Signeta peron**, male upperside (QLD)

These were divided into two groups; **A**. male without sex brand – *Trapezites* Hübner, (1819), *Anisynta* Lower, 1911, *Oreisplanus* Waterhouse & Lyell, 1914 and *Mesodina* Meyrick, 1901; **B**. male with sex-brand (on forewing) – *Hesperilla* Hewitson, 1868, *Toxidia* Mabille, 1891, *Neohesperilla* Waterhouse & Lyell, 1914, *Motasingha* Watson, 1893, *Dispar* Waterhouse & Lyell, 1914 and *Signeta* Waterhouse & Lyell, 1914. Further modifications were made to this arrangement by the inclusion of two additional genera (both without sex brands), *Pasma* Waterhouse, 1932 and *Croitana* Waterhouse, 1932 in subsequent research. I also added the genera *Antipodia* (1984), *Proeidosa* (1973) and *Herimosa* (1994) to this subfamily. The discovery of the life history of several species also played an important role in the re-defining of some genera groups, which included the recognition of three distinctive larval forms within nine genera studied (Waterhouse, 1927). These genera groups are defined mostly by wing-vein alignment and male wing sexbrands, labial palpi, antennal clubs, leg spines and juvenile (egg, larva, pupa) differences. The majority of their larvae feed on grasses or sedges (like most of the linked genera included in this article), but two important genera feed on the Australian endemic *Lomandra* or *Patersonia* (Liliales).

Phylogeny

W. H. Evans in his important analysis of the world's Hesperiidae held in the British Museum (Natural History) (1937-1952) had accepted the arrangement of the subfamily Trapezitinae "adopted by Australian authors", probably referring particularly to Waterhouse (Evans, 1949), but in this work he also recognised a possible taxonomic relationship (hind-wing venation) of trapezitines to the New Guinea genus *Prada* Evans, 1949 (p. 31). This genus, together with the monotypic *Tiacellia* (described by Evans on p. 37), was placed within the *Prada* subgroup of the Plastingia Group J. (1949, p.2). Evans in this work characterized the peculiar cell end of the hind-wing of the Australian group "… lower angle is upturned, the end cell is directed to the dorsum, instead of to the tornus or termen as usual and the medium vein has a branch to the origin of vein 4 (M_3), instead of to well above that point.

Plate 2

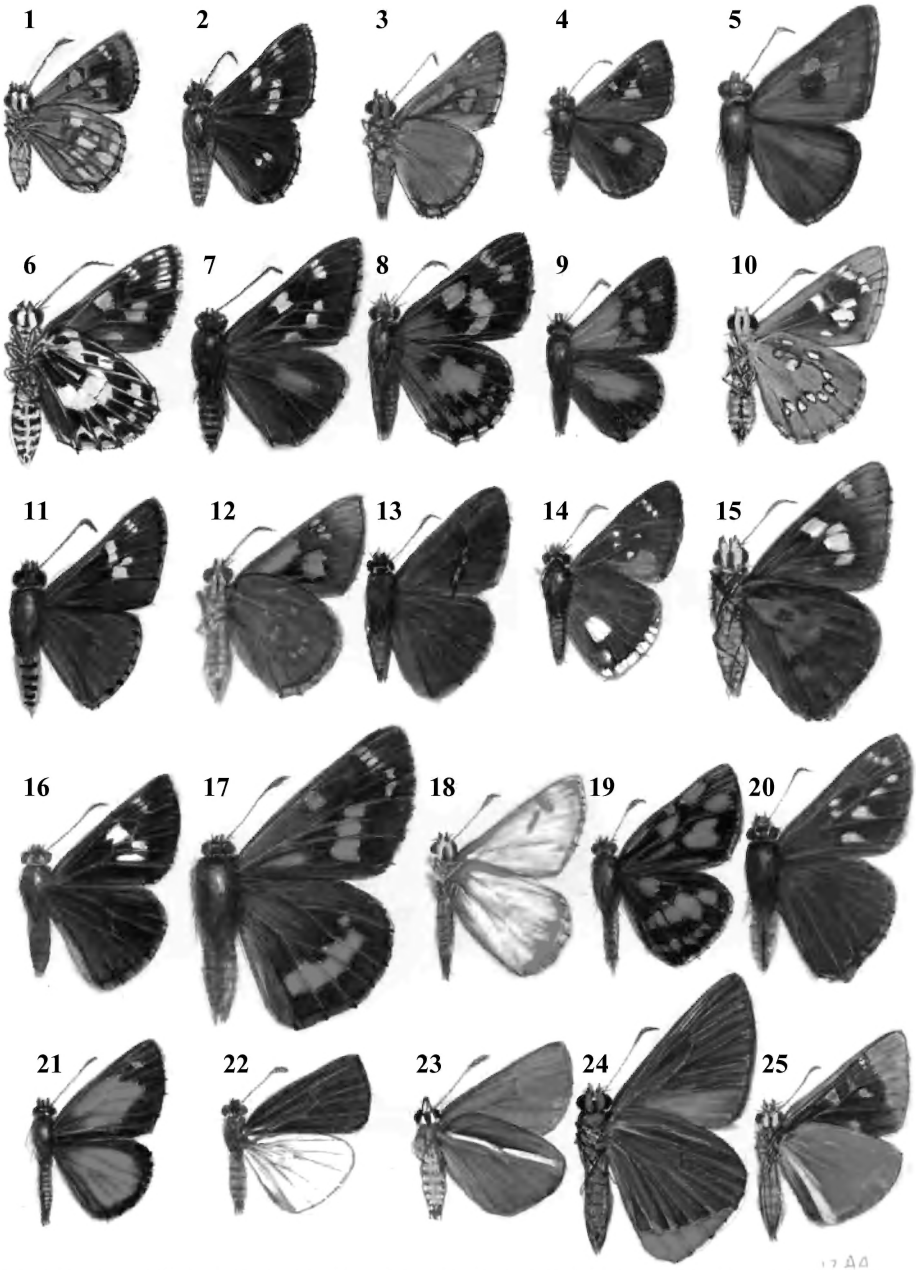


PLATE 2 (all Trapezitinae, except where marked (HESP) = Hesperiinae, or (HET) = Heteropterinae.

(1) *Anisynta monticolae*, female underside (VIC); (2) *Pasma tasmanica* male upperside (NSW); (3) *Neohesperilla xanthomera*, male underside (QLD); (4) *Dispar compacta,* female upperside (VIC); (5) *Signeta flammeata,* male upperside (NSW) (large specimen); (6) *Oreisplanus perornata*, female underside (VIC); (7) *Motasingha trimaculata*, female upperside (NSW); (8) *Antipodia chaostola*, female upperside (VIC); (9) *Croitana croites*, male upperside (WA); (10) *Proeidosa polysema*, female underside (QLD); (11) *Mesodina hayi*, male upperside (WA); (12) *M. aeluropis*, female underside (NSW); (13) *Toxidia melania,* male upperside (QLD); (14) *Felicena dirpha*, male underside (PNG); (15) *Hewitsoniella migonitis,* male upperside (PNG); (16) *Pedesta masuriensis*, male upperside (Himalayas) (HESP); (17) *Agathymus aryxna*, male upperside (USA) (HESP 'Giant Skipper'); (18) *Argopteron aureipennis*, female underside (Nicaragua) (HET); (19) *Metisella midas*, male upperside (Kenya) (HET); (20) *Pelopidas agna*, female upperside (QLD) (HESP); (21) *Fulda corolla*, male upperside (Madagscar) (HET); (22) *Dalla semiargentea*, male upperside (Peru) (HET); (23) *Tsitana tulbagha,* female underside (South Africa) (HET); (24) *Pirdana hyela* female underside (Borneo) (HESP); (25) *Butleria fruticolens* female underside (Chile) (HET)

Vein 5 (M_2) is always well marked, at the termen central between veins 4 (M_3) and 6 (M_1), nearer to vein 6 (M_1) at its origin, where it is often decurved" (p. 19).

It is clear that both Waterhouse and Evans were somewhat at variance (or even contradictory) in the identification and morphological parameters of the Trapezitinae, although they agreed on its uniqueness. However, Parsons (1998) in his work with Papuan skippers doubted the validity of Trapezitinae, indicating the 'diffuse' nature of this subfamily with Hesperiinae, illustrating variable states in the discocellulars (linking veinlets at the end of the cell) of the hind-wing in some New Guinea genera. Comparisons were made to *Toxidia inornatus* (Butler, 1883)*, Rachelia extrusus* (C. Felder & R. Felder, (1867), *Tiacellia tiacellia* Evans, 1949*, Prada maria* Parsons, 1986*, Prada papua* (Evans, 1928) and *Prada rothschildi* (Evans, 1928).

The DNA (bar-coding) of skippers

In 2008 Andrew Warren *et al*. formulated a tentative systematic arrangement of the skipper butterflies based on the DNA of many (about 30%) of the genera found throughout the world. This momentous molecular study, which also included an updated review of morphological definition, confirmed the subfamily status of Hesperiinae, Heteropterinae and Trapezitinae (the latter had received some 'doubtful press' in recent years!). The work included some species in several genera of the Australian subfamily. Since this work, a number of authors have contributed limited DNA studies on various other genera groups and families of butterflies circumscribed by the Papilionidae, Hedylidae, and Hesperiidae.

Warren has shown that aligning morphological data with that of molecular results can enhance the perceived phylogenetic arrangements of the Hesperiidae, including a greater clarity in the placement and connectivity of genera groups. In the new phylogenetic arrangement, a more comprehensive hierarchic connectivity to continental faunas could be perceived. However the apparent evolutionary stasis and long evolutionary time frame achieved by skippers (a fifty million year old fossil

Plate 3

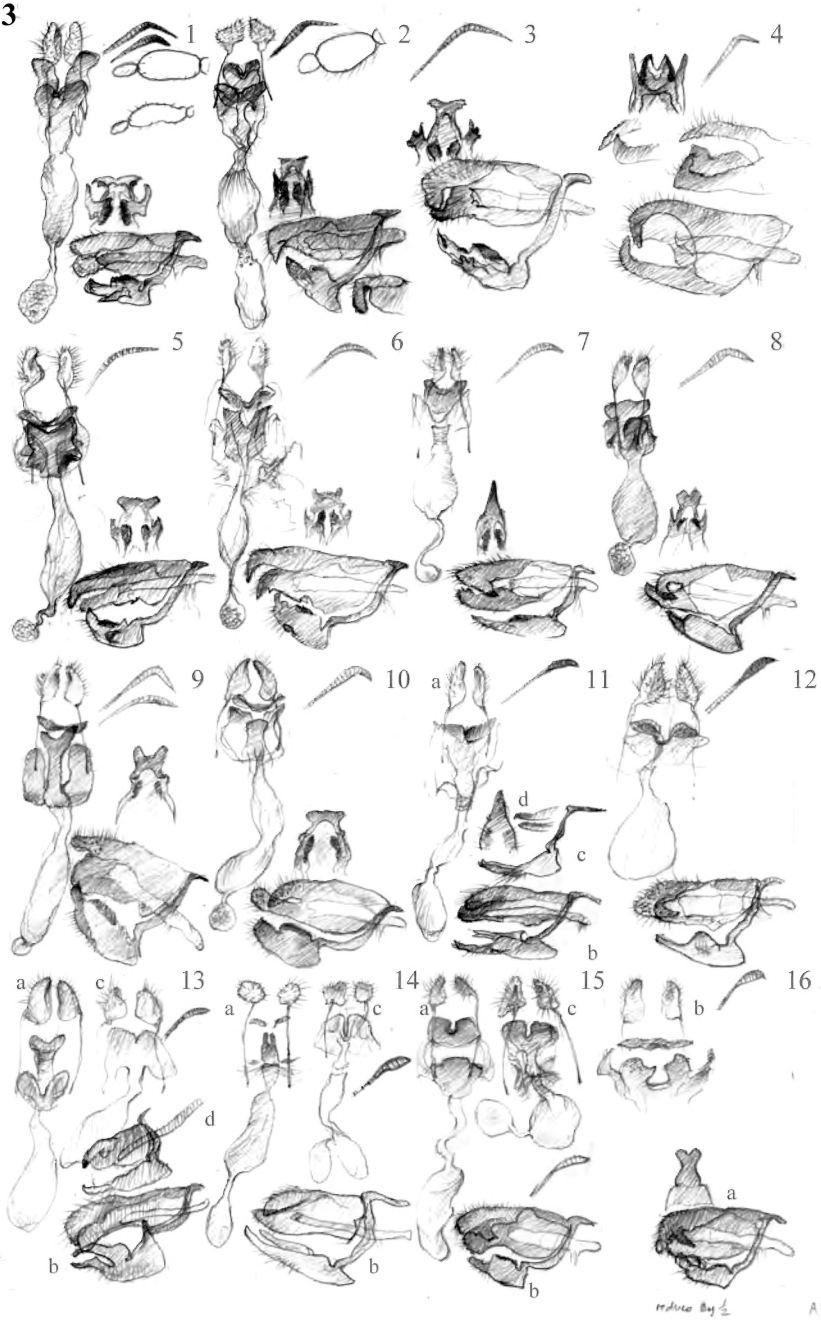


PLATE 3 (all Trapezitinae, except where marked (HESP) = Hesperiinae, and (HET) = Heteropterinae. Anatomical features of skippers; mostly male and female genitalia (including uncus tip of male gnathos); also antennal club, and some labial palpi.

(1) *Trapezites symmomus* (Eungella, QLD) (also included smaller labial palpi and antennal club of *Trapezites sciron* from WA); (2) *Rachelia extrusa* (Cape York, QLD); (3) *Hewitsniella migonitis* (Sariba Is., PNG); (4) *Felicena dirpha* (right and left valvae tips, and below subspecies *F. d. nota*) (both PNG); (5) *Toxidia melania* (Nth. QLD); (6) *Signeta flammeata* (NSW); (7) *Dispar compacta* (VIC) (note narrow, pointed uncus-tip); (8) *Pasma tasmanica* (NSW); (9) *Neohesperilla crocea* (NT), uncus tip *N. xanthomera* (QLD); (10) *Anisynta sphenosema* (WA); (11) a. *Piruna pirus* (female) Nth Amer., b. *Dardarina aspila* (male), c. *Argopteron* sp. (male) (Chile) d. *Butleria soloi* (gnathos tip) (male) (Chile) (all HET); (12) *Tsitana tulbagha* (Sth. Africa) (HET); (13) a. *Fulda rhadama* (female), b. *F. coroller*, c. *Hovala amena* (female), d. *H. amena* (male) (all Madagascar and HET); (14) a. and b. *Metisella malgacha erina* c. *Hovala sacauus* (both Madagascar and HET); (15) a. and b. *Malaza carmides*, c. *Malaza fasturus* (female) (both Madagascar and HESP?); (16) a. *Agathymus aryxna* (male genit.) (Arizona, USA), b. *A. ricei* (USA) (both HESP)

skipper is reported, differing little from extant species), has provided little additional structural, distinguishing elements for comparative research. More fossils were needed!

Other Australian Groups

Euschemoninae, Coeliadinae, and the South American Eudaminae are the three basal subfamilies with morphologically constant structural characters that separate them from the other four subfamilies, or even from each other. In fact, at the subfamily level, each exhibits essentially a mosaic of collective character-sets and biological traits that differ in a quantitative arrangement rather than clear division. This includes genital morphology, which unfortunately shows variation and, enigmatically, a complexity that defies taxonomic solution. Nevertheless the adult and juvenile members of species in each subfamily clearly behave and 'look' reasonably different from each other. There are also some consistent structural features of each ancestral genera group (be they seemingly trivial) that can define an evolutionary pathway. From a biological perspective, the larvae of Coeliadinae and Eudaminae mostly feed on Legumes. The larva food plant of Euschemoninae is exclusively Monimiaceae. Clearly these three subfamilies show strong continental connectivity. Further detailed assessment of these dicot-feeding groups will be given in a future article.

Morphological connections – the missing links

The hierarchy of three subfamilies of mono-feeding skippers reached by Warren (2008) (Trapezitinae, Heteropterinae and Hesperiinae) gave evidence of an important pathway to their evolution (Appendix B). It appears likely that these skippers split from the branch of dicot-feeding skippers somewhere near the pyginid genera groups (*Pyrgus*, *Spialia, Gomalia* etc. and perhaps the Australian endemic *Nycterus*). The stout, robust genus *Trapezites* carried some morphological traits of these genera.

Plate 4

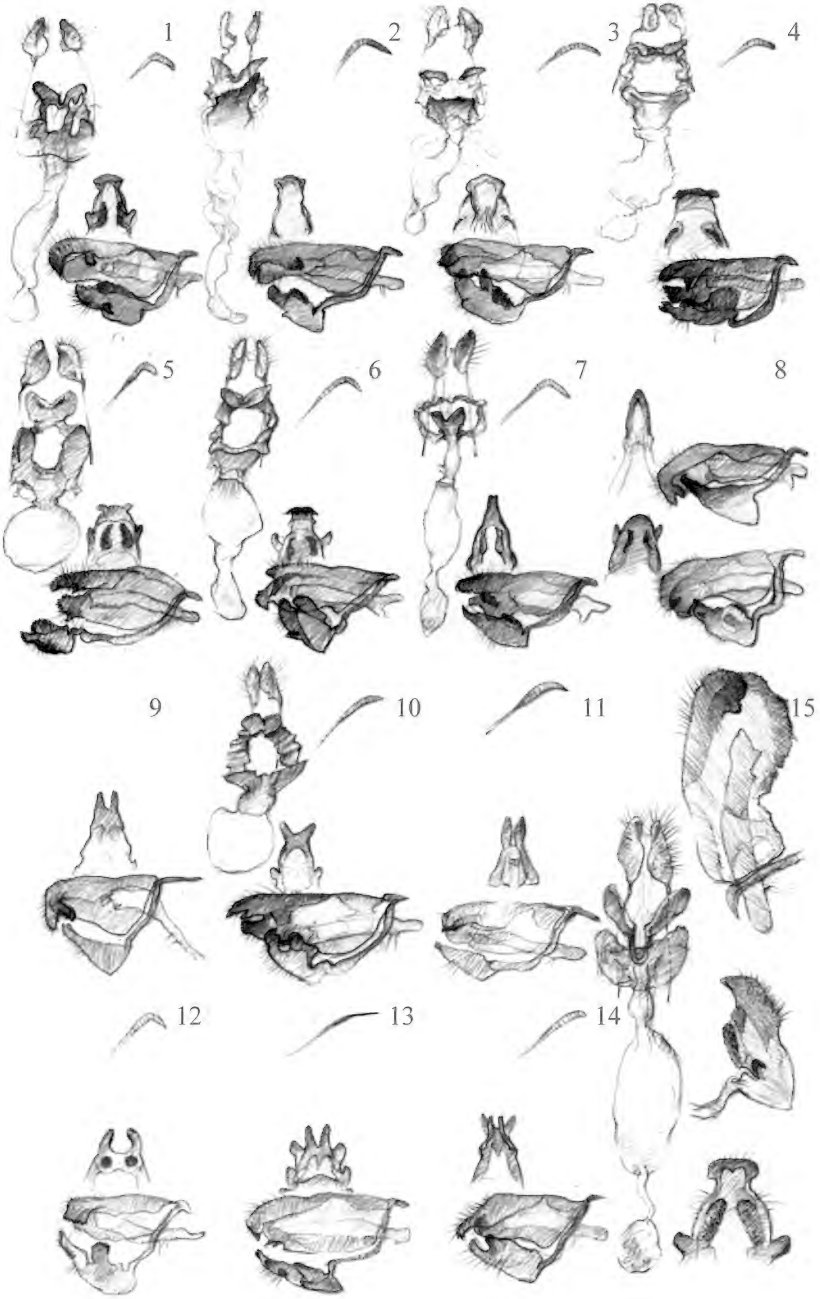


PLATE 4 (all Trapezitinae, except where marked (HESP) = Hesperiinae, and (HET) = Heteropterinae. Anatomical features of skippers, mostly male and female genitalia (including detail of uncus); also antennal club.

(1) *Motasingha trimaculata* (NSW); (2) *Hesperilla mastersi* (VIC); (3) *Oreisplanus perornata* (VIC); (4) *Herimosa albovenata* (NSW); (5) *Croitana croites* (WA); (6) *Antipodia chaostola* (VIC); (7) *Mesodina aeluropis* (NSW); (8) a. *Prada papua*, b. *P. rothschildi* (both PNG); (9) *Tiacellia tiacellia* male genit. and uncus tip (PNG); (10) *Proeidosa polysema* (QLD); (11) *Pelopidas agna* (QLD) (HESP); (12) *Pedesta* sp. (Nepal) (HESP); (13) *Pithauria* sp. (Malaysia) (HESP); (14) *Pirdana hyela* (Borneo) (HESP); (15) *Trapezites atkinsi* (WA)

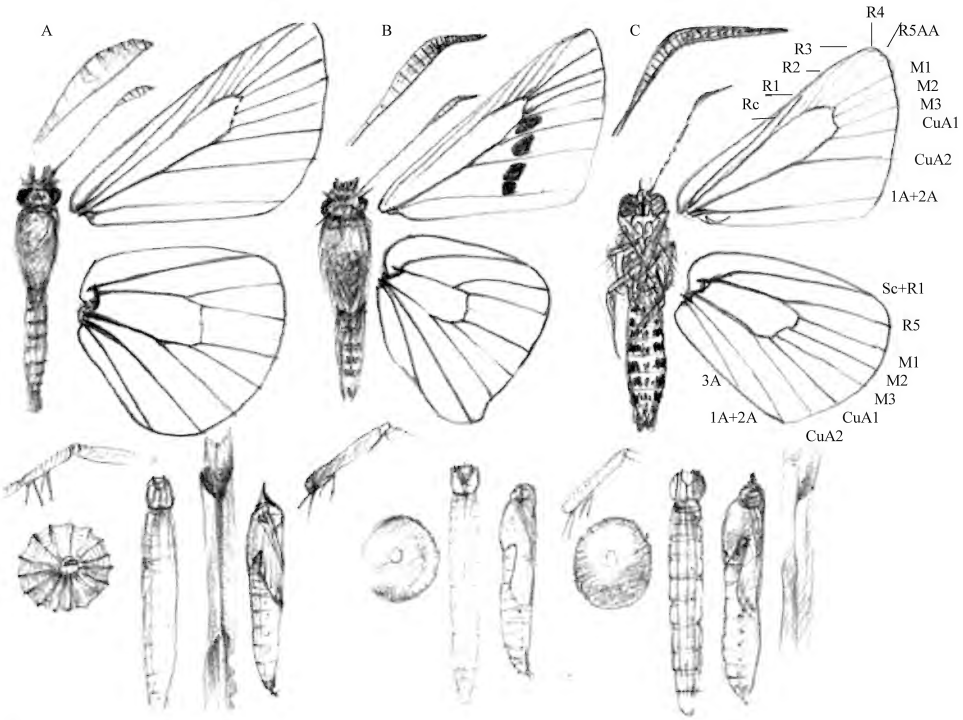
The morphological study (black and white plates 3, 4 and 5) reveals a tendency for species in the genera of trapezitines to become narrower and less robust in structure (adults, genitalia and juveniles). This may be as a result of a move to sedge and grass feeding (narrow leaf-shelters to hide in). This same structural change is seen in other continental groups of hesperiines of all three subfamilies. However their connectivity can clearly be seen in the male and female genitalia (within these subfamilies), which developed elongated, over-lapping valvae (ampulla and harpe)(eg *Anisynta*, *Butleria* and *Tsitana*), and the corpus bursae with accessory pouches (appendix) (seen in most trapezitines and *Butleria* and *Metisella*). The eggs of species in the three subfamilies have gone from heavily ribbed to fine, multiple faint ribs, and then finely to an almost smooth surface. There is also a general trend for the antennal clubs to be blunt and short and have broader, more rounded wings, especially genera groups that fly low in exposed, open habitats of cooler climates. Generally, species flying in rainforests have retained (speed-adapted) narrow and long fore-wings and have more startling wing patterns and colours (although there are many exceptions to this rule). Overall, along the family tree, there has been a general evolution of structures from complex to simple, accompanied in some genera by a loss or movement of wing-veins (especially illustrated in the black and white plates).

Conclusion

Compared to other families of Lepidoptera, Hesperiidae (skippers) are poorly known, and yet they comprise more than a quarter (between 3,500 and 4,000 species) of all described butterflies. Following comparison with molecular research, a preliminary overview of the higher systematics of skippers is given (Appendix B). A preliminary ranking as a possible tribal relationship of the Trapezitinae is shown in Appendix C. A few additional structural and biological defining characters are included.

Although all Australian, African and South American genera studied yielded a scattering of species with very similar structural features (note the similarities of wing venation male and female genitalia, antennal club shape etc.), but these were not shared by all genera. Some structures were almost randomly shared, as if the genes operating these structures were held latent and expressed or re-expressed well after the genera had evolved from their original (ancestral) genera group forms.

Half-Plate 5a

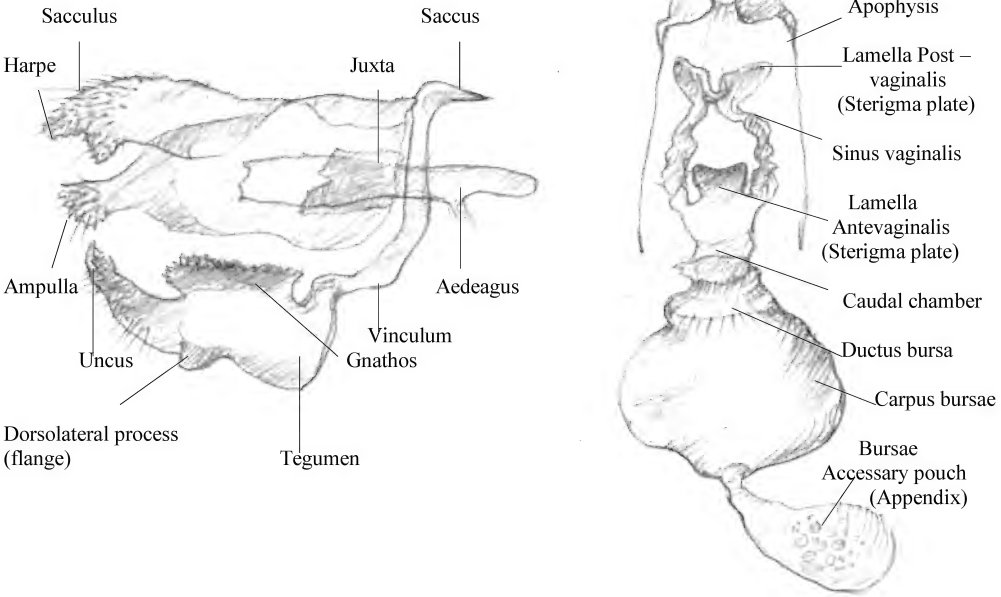


HALF-PLATE 5a. Wing venation, antennal club, hind leg spurs, egg, larva, larval shelter and pupa of male monocotyledon skippers (note downward sloping of veins M2, M3, CuA1 and CuA2 at cell in forewing and faint M2 of hindwing of fig. B which are noticeable variable trends in many species of hesperiines throughout the world). The three species illustrated have larva that all feed on grasses but have quite different eggs.

A. ***Butleria flavomaculata,*** **HETER. (Chile)**
B. ***Telicota ancilla*****, HESP. (Newcastle, NSW)**
C. ***Oreisplanus munionga*** **TRAP. (Mt. Hotham, NSW)**

The relationship of the Trapezitinae with Heteropterinae appears quite strong (molecular and morphological), all containing various 'quantities' of characters. These features include, bar-codes, long and slim build, blunt antennal clubs, complete venation and ribbed eggs, and in female genitalia, accessorary pouches. The males have distinctive, overlapping valvae tips and elongate uncus. In at least one genus, several species had strongly ribbed eggs (especially in Trapezitinae). Most species in the genera of the Hesperiinae have only fine ribs or more often smooth eggs. This latter character is important in the phylogenetic study of the monocot-feeding genera.

Half-Plate 5b



HALF-PLATE 5b Male and female genitalia of Trapezitinae (generalized).

A few genera of African Hesperiinae feed on dicotyledons and also appear close to Trapezitinae (especially in juveniles) but I have not closely studied those groups. Little is known about the biology and life history of Madagascan genera (the heteropterines and so-called hesperiines (*Hovala*, *Malaza* etc). They are clearly of African stock, but older, and appear linked to Australasian trapezitines. (Did you spot the accessory pouches?)

The molecular data shows the position of the two subfamilies Trapezitinae and Heteropterinae in a phylogenetic ranking as the ancestral groups of all other monocot-feeders. Other genera groups appear to have evolved from them, presumably as separate continental entities following continental drift. They then have finally spread into the northern hemisphere, mixing in a vast complex of inter-connecting skipper fauna between the 'old world' and 'new world'. A scenario involving the timing and routes taken in the vicariance events of a putative Gondwanan skipper fauna is difficult to establish without further improved molecular studies based on more

species in more genera (and of course fossils). Thus the process in which the hesperiine fauna filtered into northern landmasses cannot clearly be defined, but island hopping is unlikely at least until the continents collided. Interesting too, is the exact relationship of the Yucca-burrowing megathymids (Giant Skippers) (Plate 2, fig. 17) from Central America. They are clearly hesperiines, but also have some structural affinities to the heteropterines and trapezitines (and like the genus *Trapezites,* they have robust larvae that also feed on Liliaceae This hypothetical scenario will undoubtedly also involve the pyrginid skipper subfamilies Euschemoninae, Coeliadinae, Eudaminae and Pyrginae, (my present research). All this needs further study.

The world distribution and subtle morphological connectivity of these groups form an interesting framework for more comparative bio-geographical, phylogenetic and improved molecular research. There is little doubt that skippers are a group of butterflies with a strong bi-centric distribution across the world. This indicates that they originated in Cretaceous Gondwana. The scenario parallels the distribution and evolution of songbirds (passerines) which DNA bar-coding research has strongly indicated an eastern Gondwana origin (Cracraft, 2001). There are many other examples of this distribution pattern of biota. Some researchers doubt that butterflies are old enough – that is to have a late Cretaceous origin. Time will tell!

Footnote

The classification of skippers is fraught with difficulties due to their morphological stasis, and it is unlikely that further morphological cladistic methods will clearly define the 'natural' genera and tribal groupings, or indeed to greatly improve the arrangement presented by Evans (1937-1955). Perhaps a multi-dimensional 'Quantum' gene analysis could be the answer to an unambiguous phylogeny of skippers?

My work was primarily based on morphological comparison of species in the extensive collections held by the Natural History Museum, London (1978-81). Since then some regional faunal studies (including cladistic) have altered or modified the classification. Many more species have been described and biological work has added further depth but, by and large, Evans' morphological model has 'held' as it systematically dealt with a progressive 'country-to-country' faunal assessment: in other words he recognised the strong continental endemism of skippers.

Today, I am certain that those little Aussie battlers, the Trapezitinae, have taken a key role in the evolution of skippers, or at least have a pivotal place in the development and distribution of the monocot-feeders throughout the world. Am I jumping the gun? Well maybe, the signs (the pattern) are there, it just needs someone to follow this up.

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APPENDIX A
List of skipper genera studied in this document

TRAPEZITINAE (Australasian)
Hewitsoniella (PNG)
Rachelia
Trapezites
Tiacellia (PNG)
Prada (PNG)
Toxidia
Signeta
Pasma
Dispar
Felicena (PNG)
Neohesperilla
Anisynta
Motasingha
Oreisplanus
Hesperilla
Croitana
Herimosa
Proeidosa
Antipodia

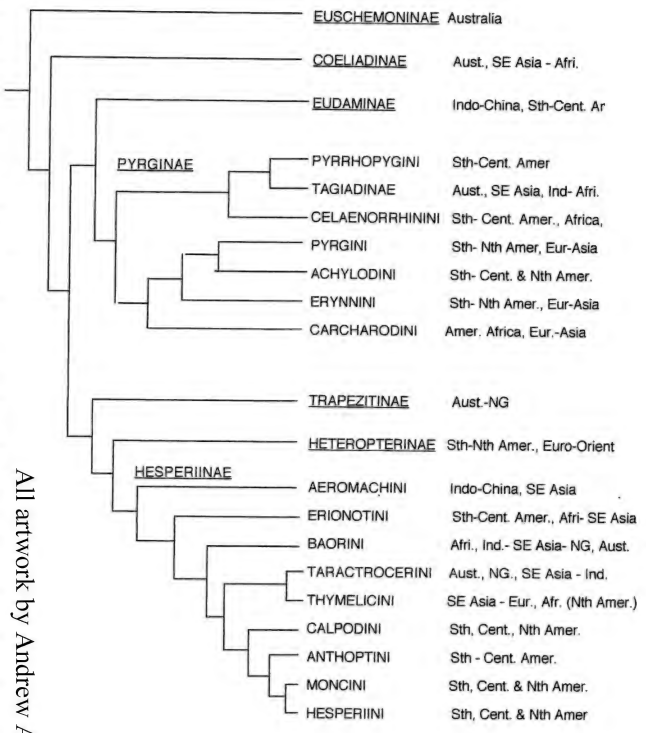
HETEROPTERINAE (South and central America)
Dalla (Sth America)
Piruna (Mexico)
Argopteron (Chile)
Dardarina (Chile)
Butleria (Chile)

HETEROPTERINAE (Europe)
Heteropterus (France)
Carterocephalus (Scotland)

HETEROPTERINAE (Africa)
Metisella (South Africa)
Tsitana (South Africa)
Hovala (Madagascar)
Piruna (North America)

Appendix B

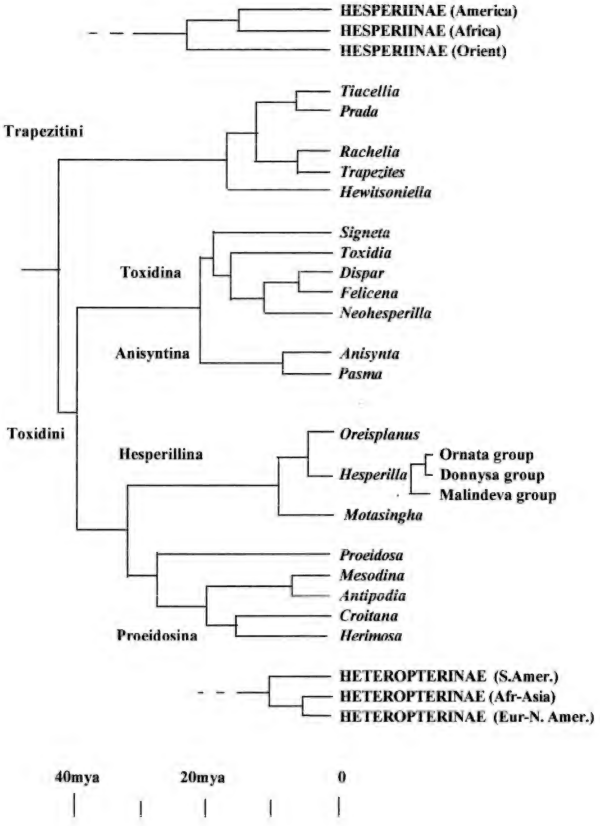
Phylogeny of the subfamilies and tribes of the skippers (Hesperiidae) of the World (including distribution), after Warren, *et al*. 2008



All artwork by Andrew Atkins

Appendix C

Proposed Phylogeny of the Trapezitinae (Atkins present research)



Moths Milling About – *Densey Clyne*

The dust from colliding wings is swirling around us and the smell of dead bodies clogs our nostrils. Jim Frazier and I are standing near a mercury vapour lamp outside a wood chip mill in the small town of Oberon, NSW. The wings belong to gyrating Bogong moths (*Agrotis infusa*) and the smell is the end result of their kamikaze flights into the hot lamp.

It is November 1984. We are on our way to a location in the Snowy Mountains of New South Wales to film the story of the Bogong moths' annual summer migration. Their route covers a vast area that includes many human settlements and these days their insect odyssey can be fatally interrupted by street and house lights. Oberon is one of the moths' important staging posts and we have stopped here to film their impact on the activities of the district's major wood chip industry.

Inside the mill, we watch the procedure. Here finely ground wood chips are put through rollers on a conveyor belt to make particle boards used in cabinet-making. But there is a problem. Moths, sheltering around the machinery by night, have been disturbed and fly about in panic. Outside, they hit the lights and fall to be prey to carab beetles. Inside, an employee waves his arms to keep them from the rollers but alas! the occasional moth ends up as a two-dimensional imprint on the board. I find this gruesomely artistic; Jim calls it instant fossil! Affected boards are rejected and we claim one each to take home. Now we finish filming the collision of two worlds around this small town and move onward to where the vast majority of insect sojourners have reached their destination.

The story of the Bogong moths is an amazing one. For millions of years, before there were towns with wood chip mills and two-legged mammals to operate them, the moths have been making this same journey over much of eastern Australia. The saga begins annually in Spring. In lowland plains and pastures, the small herbaceous plants that nourish the moth caterpillars are dying off. Feeding through winter, the caterpillars have pupated and now fat brown moths are emerging. No need to eat – they emerge fully energised for flying. A short time to spread their crumpled wings, a few trial flights in their new element and they're off on their arduous journey from the plains to the Victorian Alps. Streams of moths converge to form huge flocks, driven by stages along mysterious pathways to traditional aestivation spots. There they wait out the summer in the cool comfort of granite caves and crevices.

It is at one of these remote locations on Mt. Gingera that we are to film them in their summer hideaways for the BBC. Earlier that month I join Dr. Ebbe Nielsen, then head

of the Insect Collection at CSIRO, and moth expert Dr. Ted Edwards on a trip to Mt. Gingera to check out a suitable location that Ted knows of. As we trudge up a grassy subalpine slope I learn more from my entomologist companions about human interactions with the moths. Going back thousands of years Australian aborigines regularly followed the moths up to the mountains, lit their campfires there and enjoyed a huge seasonal feast of roasted moths. Ted tells me they themselves have actually cooked and eaten the moths and found them quite tasty. But what about all that fur!

We arrive at a level patch of ground between huge boulders. Eucalypts are in flower but there's no sign of the moths. Where are they? My companions point me towards a crevice, barely discernable. I shine my torch in and can hardly believe my eyes. The rock wall is festooned with thousands of moths, overlapping like tiny brown tiles. I manage with my small camera to take some shots by flashlight. "That's only one shelter:" I 'm told. "All these rocks around here are hiding thousands more." But the land ahead slopes steeply and this will be the only accessible site for Jim to film the moths *in situ.*

A week later, Jim and I arrive at the site with colleague and fellow cameraman Glen Carruthers as his assistant, ready to do the filming. But in that narrow crevice where the moths are hiding there is barely room for one man and a movie camera. So Jim has access to only one of the moth's hiding places. He told us later of his problems. To begin with, it was a mighty squeeze through the entrance. Inside the floor was thick with the corpses and discarded wings of earlier sojourners. The wing scales he stirred up rose around him as he crawled close to the ground setting up the camera. At his feet scuttled a number of carab beetles, scavengers feeding on the old moth corpses. It was dark, of course, and getting movie lights in place was not easy. Well, notwithstanding bruised shoulders, barked shins and a nose full of moth dust, Jim manages to get the shots we need.

Next task is to film the moths as they come out of hiding in the early evening. Right on time, they start swarming around us, settling to feed on the blossoms of the stunted alpine eucalypt trees. It is quite a dizzying experience as the moths swerve around us, filling the air and sky, miraculously managing to avoid hitting us. Jim gets wide shots of the moths against the evening sky and settled in the foliage. I use my camera for still shots of a moth probing the gum blossom with its long tongue. And then we light our way down-hill to our waiting vehicle and head for home.

The film is sent for processing and comes back to us: relief all round – no problems! Off it goes to the BBC in England and later our secretive Australian Bogong moths are out there entertaining TV viewers all over the world.

Bogong moth territory – Mt. Gingera

Bogong moth feeding on Snow Gum

Bogong moths clustering – Mt. Gingera

Instant fossil –
moth in chip board

Bogong moth corpse being eaten

Photos Densey Clyne

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The Fiddler Beetle (*Eupoecila australasiae*) –

Observations by *Hongming Kan*

The Fiddler beetle (*Eupoecila australasiae*) is a very common flower beetle in eastern Australia. It gets its common name from the interesting patterns on its back reminiscent of a violin. In summer, I often find them on flowers in suburban gardens and parks. They are so common in summer that sometimes they have even flown into my house. These beautiful intruders were always welcome and treated with their favorite food --- apples and bananas.

Adult on flower

Feeding trails under bark

Fiddler beetle larvae

Female Fiddler Beetles lay their eggs in rotting logs or in the damp soil under logs. The larvae live inside rotten tree trunks just beneath the bark. Unlike the larvae of stag beetles that like to bore into the rotten wood, flower beetle larvae like to graze the surface under the bark and rarely venture deep inside the log. Fiddler beetle larvae are pretty tough and not picky about the food. They can be found in fallen logs that are too hard or dry for other beetle larvae and I think that is one of the reasons why they are common.

If compared with raising stag beetles, raising fiddler beetles is really easy. They require minimum attention and all you need to do is put the larvae into a container filled with rotten wood and then you can almost forget them. In spring adults will duly emerge.

Before pupating, larvae use their excrement and debris to construct cocoons.

Fiddler beetle cocoons

Mature pupa in cocoon

Just as for other beetles, a fiddler beetle needs to remain dormant inside its cocoon for a period of time ranging from several weeks to months before it emerges and its new role as an adult begins.

Days before emerging, the beetle is already clearly visible inside the pupa. When the adult is ready to emerge, it uses its legs and body to wriggle and struggle out of the pupal case and cocoon. The whole process can take a day. This is the most vulnerable moment in its entire life because if anything goes wrong, the beetle may die or suffer deformation.

Adult ready to emerge from cocoon

The adjacent photo shows the moment when I broke open a fiddler beetle cocoon and found a fresh beetle inside.

The back of the newly emerged fiddler beetle is soft and creamy. It takes days before the wing casings become hard and the colour darkens.

Emerging adult

Colour developing on newly emerged adult

After all their parts are fully hardened, the adults are ready to mate and commence a new breeding cycle.

Photos Hongming Kan

Life history notes on the Large Grass-yellow, *Eurema hecabe hecabe* (Linnaeus, 1758) Lepidoptera: Pieridae – *Wesley Jenkinson*

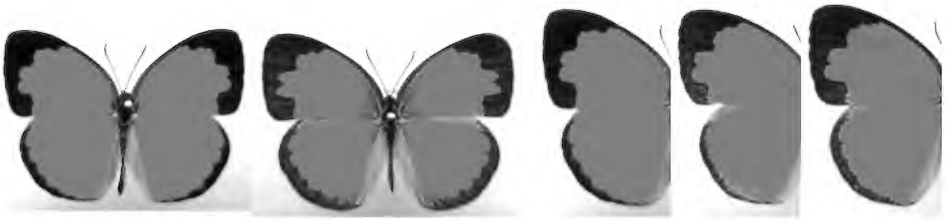
The Large Grass-yellow previously known as the Common Grass-yellow is encountered across much of northern and eastern Australia. Within its breeding range, this species is one of our most common butterflies.

The adults can be located in a variety of habitats where the host plants are established; chiefly in grasslands, open woodland, eucalypt open forest and in suburban gardens where there is suitable habitat. Dispersal of this species from its breeding areas depends on regional rainfall and the availability of its host plants. There are dry and wet season forms with some adults being intermediate between the extreme forms pictured.

Adults have a slow erratic flight although they can fly rather quickly if they have been disturbed. They are found flying close to the ground in grassy areas but will fly much higher in search of nectar or over obstacles. During hot summer days, large numbers of the adults can be observed imbibing moisture from mud puddles and moist gravel areas along creeks. While feeding, the wings remain closed. The adults are active during warm sunny conditions but tend to settle during heavy cloudy periods only to take flight again when the cloud has cleared. The adults are readily attracted to a wide variety of small native and exotic flowers. The males do not hilltop.

Whilst in flight, the adults can be very easily confused with other species in the *Eurema* genus, in particular, the Scalloped Grass-yellow (*E. alitha*) which is very similar in size and markings. Smaller adults (runts) can occur particularly if the larval food is in short supply. Voucher specimens are generally required to determine correct identification between these two species but even then some specimens can be difficult to separate. *Eurema alitha* has only been recognised in recent years in Australia and was first included in Braby 2000.

In comparison to *E. alitha*, *E. hecabe* is a slightly paler yellow, and the top yellow 'tooth' on the forewing black margin indentation is generally shorter than the lower tooth and sometimes broader. The hindwing upperside may also have slight but less obvious scalloping along the margin. Other *Eurema* spp. are generally smaller in size and (with the exception of *E. puella* from Cape York Peninsula) the wide black marginal band on the upperside forewing does not extend to the tornus. In both species, the black markings on the upperside show slight variation in the shape. In addition, both species also feed on separate host plants.



Images left to right: male & female *Eurema alitha*, male *E. alitha, male E hecabe, male E. hecabe*

The sexes are rather similar in appearance. Males have a sex brand (or patch of sex scales) along vein CuA on the underside of the forewing. The females are also a slightly paler yellow and, in particular, the wet season form has a dusting of black scales towards the base of fore and hindwing uppersides and a broader black suffused margin along the upperside of the hindwing.

The sizes of the adults for both seasonal forms are similar with wingspans for the pictured males being 38mm and females being 40mm respectively.

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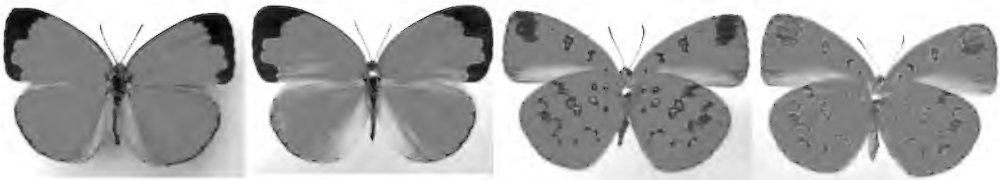
***Eurema hecabe hecabe* (Large Grass-yellow) Wet Season Form**
Images left to right: male, female, male underside, female underside



***Eurema hecabe hecabe* (Large Grass-yellow) Dry Season Form**
Images left to right: male, female, male underside, female underside

This species utilises a broad range of host plants in the following four families: Caesalpiniaceae, Euphorbiaceae, Fabaceae, and Mimosaceae. These are listed by various authors in Braby 2000. Additional host plants within these families have been recorded and published in Moss 2010.

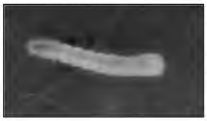
During November 2005 at Beaudesert (in southeast Queensland) a female was observed slowly fluttering around a Coffee Bush (*Breynia oblongifolia*) a known host plant. She settled on the host plant and curled her abdomen on to the upperside of a

leaf and laid a single egg. While ovipositing, the wings remain closed. This egg was kept for life history studies.

This egg was creamish white, spindle shaped with very fine longitudinal ribs, approximately 0.5 mm wide x 1.3 mm high.

Freshly laid egg

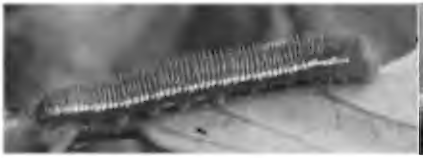
The first instar larva emerged prior to 7.00 am and consumed the eggshell shortly afterwards. It was observed feeding during daylight hours, resting on either side of the leaves and along stems of the host plant. The larva raised completed five instars and attained a length of 30mm.



1st instar larva

2nd instar larva

3rd instar larva



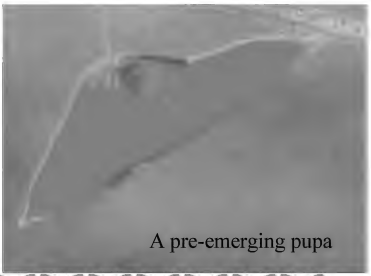
4th instar larva

5th instar larva

Pupa lateral view

Pupa with reddish-brown markings

In captivity, the pupa measuring19mm in length, was located below a stem of the host plant. It was attached with silk by the cremaster and a central girdle. The pupae occasionally have reddish-brown or brownish markings for camouflage to match the stem colour as pictured.



A pre-emerging pupa

The total time from egg to adult was almost 1 month, with egg duration of 4 days, larval duration

18 days and pupal duration of 7 days.

Within the new boundary of the Scenic Rim Regional Shire south of Brisbane, I have records of adults from all months of the year. In this region, the adults appear to be more numerous during the summer and autumn months. In this location, during some years, the life cycle is completed throughout the winter months. However, this probably relates to the timing of local temperatures and rainfall triggering fresh growth of the host plants.

I would like to thank John Moss for commenting on the manuscript.

References:

Braby, M.F., 2000. *Butterflies of Australia – Their Identification, Biology and Distribution.* vol 1. CSIRO Publishing, Melbourne.

Moss, J.T. 2010. *Butterfly Host Plants of south-east Queensland and northern New South Wales*. 3rd edition, BOIC.

Photos Wesley Jenkinson

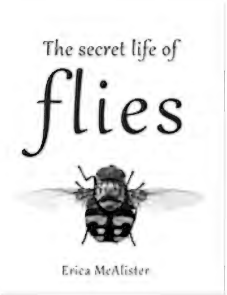
UNDER THE MICROSCOPE

This image is of part of an insect photographed under a microscope. Can you guess what it is?

See page 42 for the answer.

BOOK REVIEWS

The Secret Life of Flies by Erica McAlister – Hardback | April 2017 | $ 29.95 ISBN: 9781486308026 | 200 x 130 mm Publisher: CSIRO – Reviewed by *Bernie Franzmann*



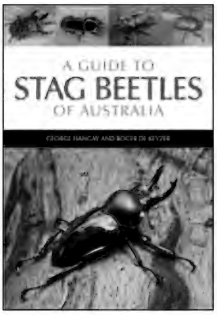
Insects are endlessly fascinating aren't they? After reading this book, I'm thinking that flies are the most fascinating insects of all.

Every second page of this book has an interesting and, usually, amazing story about a fly family or species. The book has 241 pages so there are at least 120 such stories. The stories are presented in an entertaining, David Attenborough-like style.

Erica is a staff member at the Natural History Museum in London where her job enables her to 'play with one of the best collections of flies in the world'. She has also travelled extensively, including Australia, studying flies. She says of her book "It is a book of my ramblings through the world of flies and how they interact with everything else in the environment."

Some of the stories/facts I found most interesting are as follows:

- Flies range in size from 0.4mm – 8.5cm.
- I'm sure I was taught that no insects could live in salt water, but now I learn that there are 12 genera of flies that have marine species. An even more extreme adaptation is the case of the petroleum fly, which lives in petroleum pools.
- Some adult flies can dive and remain underwater for some time by carrying 'air tanks' – pockets of air trapped by the hairs on their legs
- Some male flies have antler-like structures on their heads which they use like the antlers of deer – they use them to spar with their opponents and show off to the females.
- There is a fly in New Zealand that lives on bat guano. They hang around in little social groups and groom each other – they are getting close to being social species.
- The healing potential of some fly maggots has long been known but with increasing resistance to antibiotics, research is increasing into the antibiotic properties of maggots.
- Robber flies can be very big and robust and one species has been recorded grabbing, subduing and feeding on a hummingbird.
- Some bee flies wrap their eggs mid-air in ballast and hurl them into, or close, by solitary bees' nests.
- Some parasitic flies have 'ears' which enable them to hear and therefore find their hosts, such as crickets, grasshoppers and cicadas.
- There is a mosquito that does not suck blood but feeds on ant vomit.
- We butterfly people know about metamorphosis – egg, larva, pupa, adult and that's where it ends. Some species of fly have a unique metamorphosis. The females start out looking like an average fly but when she finds her host (a bat) she nips off her wings and legs and undergoes a post-adult metamorphosis, to resemble once more, a maggot!
- Recent developments in identifying species, uses DNA barcoding techniques. One family of flies (Cecidomyiidae) has been examined using this technique and results have led to the idea that there are possibly 1.8 million species in this family alone. A few years ago it was thought that there might be about 10,000 species in this family. Some experts have tried to estimate how many existing species of insects there are. The top estimate has been 30 million species. This may now have to be somewhat increased.
- Males of some species, wishing to mate, find some prey, wrap it up in silk and present this gift to the female and mate while she is un-wrapping the gift. It gets even more interesting than this but you will have to read the book to find out how.



A Guide to Stag Beetles of Australia by George Hangay and Roger de Keyzer. CSIRO Publishing, Clayton South, Victoria, 2016; x + 245 pp. ISBN 978 1 486302 086 (paperback) $49.95 (BOIC members' price $42 plus $13 postage) – Reviewed by *Trevor Lambkin*

'A Guide to Stag Beetles of Australia' comes as a welcome and watershed addition to the CSIRO Publishing Field Guide series. With 245 pp presented in three parts, this book comprehensively presents all the 95 currently described species. It is interesting that the Australian Lucanid fauna represents 7% of the world total of ≈1400 described species. Stag beetles are a universally popular insect group because of the prominent male mandibles which show a great variety in size and structure on many of the species. In addition, many species are splendidly coloured with metallic hues and brilliant glosses. Despite the authors describing the work as not being a monograph it goes very close to being that. Not that readers or researchers should complain as this fine work must go down as one of the best entomological books on the Australian beetle fauna.

The book is comprehensive with the first part dealing with everything you may need to know to study this attractive group of Australian insects. The authors even give a background to the origins and principles of the scientific classification system, the language of entomology, morphology and a broad breakdown of the family. Part two provides firstly a checklist of all Australian species, then provides a comparative description, biology, distribution and length in millimetres for each of the 95 species. Part three provides a complete chapter on finding stag beetles in the field, methods employed for their collection and a very good section on preservation and management of a collection of stags. Yes, the authors do indicate that for any serious study of stag beetles, 'to create and curate a collection is a must'. It's good to see in this field guide and in the recently published *The Complete Field Guide to Australian Butterflies* (Michael F. Braby, 2016) that an emphasis has thankfully returned to the importance of collecting and keeping insect collections for the betterment of science and the conservation of species. Finally, a glossary is provided, followed by a reference list.

The high points of the book are numerous. Photographs of the adult beetles, immature stages and their environments are excellent. In addition, the comparative descriptions provided to assist in successful identification of species are very useful. The glossary is comprehensive as is the reference list, although many of the references would not be easily obtainable by amateur coleopterists who perhaps would use the guide. What was of help was the image on page 12 in which the authors illustrate the key distinguishing morphological feature of the Lucanid larva which separate it from larvae of other members of the superfamily Scarabaeoidea. This was particularly helpful to me as I have always questioned my identification of Lucanid larvae.

With such a plethora of positives for this book I am happy to say that there seems to be few negatives. A few little annoyances crept in when using the book. With so many genera and species that look similar, it might have been a very good idea to start a new genus on a new page so that delineation of the genera was made a little easier. In addition, on each uneven page number, it would have been helpful to include the genus name next to the subfamily name at the top of the page, again to make the book a little easier to use. Having a scale bar next to each image that is displayed on a white background would have been a good feature to aid identification. One of my pet gripes about all the CSIRO publishing field guides is that because of the nature of the spine used in each book, consequently the book does not stay open on a flat surface without the need to hold the book open with two hands. If these are field guides or even guides used in one's study, how is it possible to examine an insect specimen in question and at the same time hold the books open using two hands. I found this particularly troublesome with the Lucanid field guide as I was not familiar with the genera and when opening the book at the correct section it would close again when picking up each specimen to identify. Very frustrating!

But overall, the authors George Hangay and Roger de Keyzer should be congratulated on producing a fine publication and obviously a labour of love. In addition, their hard work has made a wonderful contribution to the knowledge of this brilliant group of Australian beetles. Well done!

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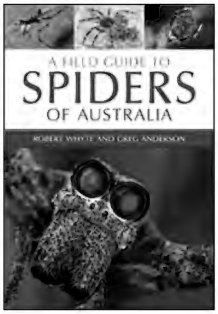

***A Field Guide to Spiders of Australia*. Robert Whyte & Greg Anderson.** CSIRO Publishing 2017. Paperback 452pp; ISBN: 9780643107076 (pbk.).~AU $49.95. (BOIC members' price $42 plus $13 postage) –
Reviewed by *Kelvyn L. Dunn*

Peering from the front cover is a blue-eyed monster – at least, that is how macro-photography presents a new vision of this 18 millimetre-long life form! Some may advance a biased view that those beady eyes and that intrusive stare are loveable in a way, and they could be, but with a name such as the Ogre-faced Net-caster, this spider has little chance of receiving the benefit of the doubt! This richly illustrated field guide shows more of its form elsewhere including those eight spindly legs and drab abdomen dangling below, leaving the viewer convinced that it is an aptly named beast and perhaps, to some, down-right creepy! This raises the question as to what is ugly (if that is an allowable description), and what is not – certainly no new theme in the minds of naturalists. Charles Darwin had argued in *The Origin of Species* that the concept of beauty (or ugliness as the opposing case may be) is largely a subjective one, and after studying an array of phytoplankton, he remarked of how, "Few objects are more beautiful than the minute cases of the Diatomaceae". And, questioning his readers to uncover underlying assumptions in a way similar to

Socrates, he asked, "… were these created that they might be examined and admired under higher powers of the microscope?"

The digital camera – the microscope of the masses – has allowed citizen scientists (and curious members of the public) to look aghast at the face of this frightful spider, with his frontal eyes enlarged to the size of humans exposing 'cuteness' for the emotive concept that it really is. Readers of this new book might be surprised to learn though, that those eyes – tiny as they actually are – are more than 2000 times as sensitive as our own! Indeed, that species featured on the cover has better night vision than anyone could image; readers will learn, no doubt with astonishment, that both sexes cope with sunlight by digesting their retinas and re-growing them each evening to prevent blindness! And if that is not enough to fascinate, then reading of the mystique of its genital coiling, which brings up new wonderment in sexual engineering will leave the newbies to spiders wondering what next they will learn! Among slaters, which are a group of terrestrial crustaceans, both left- and right-handed individuals seemingly exist in nature, each with their preference to turn in those directions when offered a choice and, perhaps, the same handed-phenomenon occurs among some Net-casting spiders. One could imagine that if any luckless Ogre Spiders were to use a 'dating site' for arachnids to improve on their opportunities (given the handicap of that name, for starters) that they might need to admit whether their 20-coils are spiralled clockwise or anticlockwise. No doubt this would be a vital statistic for some more 'individualised' spiders (or even those of an arising new species?) creeping out, so to speak, to reveal to other net-casters out there that theirs is of an alternative twist – which one would guess could occur in nature on probability.

Glancing through the content pages one sees spiders in their various forms and it is immediately impressing on the fair-minded entomologist (the angle that this writer is coming from) that, for some reason, eight legs seems far more disconcerting than does six. Even six can be an emotional hurdle for many people, alarmed and armed shoe-in-hand, when these uninvited extra-legged guests wander into the household! This field guide will allow 'arachnophobes' to see beauty in spiders for the first time – that is, if they can shut one eye to the ogre on the cover and skip to the Title page! That vibrant blue and red-bodied critter greeting the reader (pleasingly mimicking just six legs by that cunning alignment of a pair) could only soften the hearts of all but the most hardened eight-legged creature haters! Australian beauty in the wild frequently conjures images of parrots and lorikeets, adorned with colours arousing nothing less than a sense of admiration among nature lovers. The insects too have their equivalents, epitomised in the splendour seen in the world's largest butterfly genus, the *Delias*. But, what some naturalists may not know is that the spiders have their own awe-inspiring counterparts – 17 photo-filled pages dedicated to the genus *Maratus* or Peacock Spiders places them in the pageant too! These may be very small creatures with some only three millimetres long, but the diversity of patterns and the dazzling colours are unexpected among predators. One meets a magnificent eight-

eyed example, *Maratus volans*, on turning to the Foreword. Distracting from its four more prominent eyes (which I can only suppose is two more than makes 'Beauty' comfortable with), the Flying Peacock Spider is gorgeous with its yellow, blue and green blends, and this impression comes before it starts to dance! If toe-tapping Jumping Spiders and their prettiness is just a little shallow for those more seasoned naturalists, the opposite page depicts some amazing ant mimics! In fact, some spiders mimic not only a variety of ants but a few also masquerade as beetles and even thrips. Obviously, there is much to learn and reading this field guide is the fastest way to do so. As Tim Low wrote in the Foreword, "The Introductory chapters are loads of fun and the photos are enchanting"; his tone, which may seem rather informal for a book of this seriousness, actually reveals the book's style; a highly readable, scientifically accurate piece directed in common language for the layperson.

After guiding the reader in the use of the book, the authors expand on other spidery aspects. These include the ways and means of distinguishing the species, the history of their study in Australia, their basic body parts (essential reading as the terms are referred to frequently in the captions of the photos) and other aspects of their morphology and their ecology. The section titled 'Spider families from A to Z', with its colour-coded marginal highlights for quick reference to each taxonomic divide, implies by double entendre both the broad scope of the work's coverage and the ordering of species within the groups. That component is most of the book, and the content is largely pictorial – which is perfect for a field guide – and shows a variety of live spiders (not dead ones) for each family, some being common types others rare, with each usually presented in a natural setting. The photos are often large, enabling that rare close-up view in the field, and all are sharp. The full-page examples such as those on pages 44, 46, 48 and 50 give an impression of the many excellent images that follow, and the captions identify the species and sexes, with the spider sizes given in millimetres. Place-names record where the spiders shown were found, but because so little is known of their distributions that knowledge is presented at the regional or state level only (rather than as range-fill maps). Indeed, the authors admit concerning the fauna of tropical Australia that, "we don't yet know how many spiders we have or what they are" (p.113); they also remind that we are disadvantaged because "much of Australia is harsh, making exploration difficult" (p.5). A chapter on collecting and preserving spiders is curiously absent, but naturalists with a passion for outback travel and a desire to contribute to science (by preserving specimens) will likely soon delight in finding one or more new species in just a short time!

Snippets of biological interest are scattered throughout the book and it is only by reading all of it that one will learn of the many mind-boggling truths that remain hidden outside of the human sphere. I do not wish to short-cut readers off that pathway to discovery but will reveal just a few to whet the appetite of the keener bookworm. Firstly, some spiders are on the traditional menu as the guide mentions in passing. During my visit to the Eastern Highlands Province of Papua New Guinea some years ago, an indigenous guide pointed out the large spider occasionally eaten in

former times. That Golden Orb Weaver sighted, a species of *Nephila* (almost certainly *N. edulis*) was hastily dragged down, web and all, from amidst the tall shrubbery using a long stick. He grabbed it enthusiastically as the spider scuttled for its life, nimbly dismembering it with his fingers before dropping it near some hot coals of our smouldering campfire, where it sizzled for a couple of minutes. We ate the ash-covered cephalothorax and abdomen, the latter exuding a sloppy white mess that tasted a bit like chicken fat – remarking, whilst nibbling, that it is not considered a delicacy, though. The Latin name *edulis* means edible and the field guide tells of how the French taxonomist, Labillardiere had remarked on its recognition by one group of South Pacific islanders, clarifying that during the 18th century, "The inhabitants of New Caledonia call this spider nougui." In describing it as a species new to science back in 1799, Labillardiere did so "under the name *Aranea edulis*, meaning spiders the New Caledonians eat." (p.103). I had earlier pointed out another Orb-weaver species which I thought could add to our morsel, but my highlander companion stated that this kind, although similarly large and juicy looking, was not eaten to his knowledge and he did not wish to sample one.

The photo captions reveal other snippets of biology. The female of the Fat-legged Orb-weaver, as one example, may live up to 11 years, and as another curio, the Foliage-webbing Social Spider prefers the company of its own kind – up to 600 individuals can share some communal webs, all apparently living in harmony. The Social Huntsman also lives in colonies, sometimes with up to 300 in sheltered places but not in communal webs. Worthy of mention is that certain Wolf Spiders, being the agile and aggressive hunters that they are, can attack reptiles, and the text confirms that they occasionally kill young cane toads. Mating in spiders, which can last up to 22 minutes (reported for the 'Eyebrowed Sandalodes', one of the salticid spiders) can be an activity fraught with danger for some! Of interest, was the story of the timid Paddle-waving Jumping spider. The male of this kind hides behind a leaf and waves to the female at a distance to woo her. Eventually she is mesmerised by his display making her safer to approach (remembering that spiders are predaceous and that perhaps the male might join the menu if his waving is not convincing); what can occur – rather than a supposed love-feasting event in this case – is that the female sometimes grabs his paddle and tears it off! Reading more about Jumping Spiders, of which thousands of species are known to science, reveals the existence of transformation mimicry, where at different growth stages the developing spiders resemble different kinds of ants (rather than the same one).

The mygalomorphs start near the end of the book, and for those who are 'just coping' with the Peacock varieties, turning to the magnificent photo of Bradleys Mouse Spider on page 380, showing one of its book lungs alongside its shiny black legs, hairy abdomen, and its prominent fangs fearlessly greeting the viewer, might be a little overwhelming! It gives a taste of that lack of cuteness to follow, which includes the Funnel Webs, Trapdoors, and Australian Tarantulas. The final section on spider groups deals with many 'Little Known Spiders' which I would suppose that most

enthusiasts are less likely to meet (and that may be why it is out of taxonomic sequence). It includes the notorious Brown Recluse Spider, an unwelcome addition to the fauna of Adelaide where it is becoming widespread and common, and which, unfortunately, can cause a noisome sore at the bite site.

The glossary of terms, the photo credits, and a section on further readings placed towards the rear, are standard features of faunal guides and the work closes with an index of scientific and common names (which includes some key terms), followed by a supplementary one on family common names. The final double page provides a family tree of spiders showing a view of the contemporary phylogeny of these arthropods based on traditional morphology, DNA evidence, and the silk types and their uses by the spider groups. Those new to spider taxonomy will find this helps in understanding where the groups fit in amongst themselves and which are their closest relatives.

The text is delightfully readable throughout– there are just a couple of reiterative errors (pp 329 & 437) which have escaped those last minute tidy ups, but otherwise it seems flawless. Moreover, some unexpected remarks in a work of science such as, "Peacock spiders are the rock stars of the spider world" and, elsewhere, "Peacock spider fever has swept the country, with Facebook pages popping up all over the place", provide two examples of the textual flavouring that one will encounter. (And, so my earlier facetious remark on spider 'dating sites', which may have brought a frown of dismay from some pondering on the appropriateness of this literary touch of anthropomorphism, is not so out of place after all!) These raise interest in this invertebrate group, one that has been so often misunderstood as well as feared. Anticipating that many more Peacock spiders – as just one popular group under review – are still awaiting names, the guide also promotes amateur involvement whether by collection of specimens or photography, or ideally both, without seeming patronising; in doing so, it markets formal science to the masses in a way that no other faunal guide has achieved. Like other field guides in this series by the CSIRO, its glossy softcover appears durable and will withstand some wear and tear and its half A4 size will ease cartage in the field. A magnificent work from cover to cover, this guide to the spiders of Australia offers a refreshing read, one well pitched to an educated lay audience and the scientist alike.

REPORTS

Excursion to South D'Aguilar National Park/Pitta Circuit – Saturday 3rd June 2017 – *Dawn Franzmann*

The day dawned and what a beautiful winter's day it was this Saturday 3rd June. To find the parking area for the Pitta Circuit is an excursion in itself. After a lot of searching on the Park Website and following directions published in "Metamorphosis", eventually, we found the spot. As it turns out the directions stating

this area is 17kms from Walkabout Creek Discovery Centre is correct. What it doesn't say is – it is marked as the Boombana Access Point. A couple of members accessed the Pitta Circuit from the Boombana Café.

Nine members of BOIC enjoyed the Pitta Circuit walk, but a little disappointing in the fact that we didn't see one butterfly. The consensus of opinion was that this was due to the cold weather, lack of sunlight etc. However, we turned it very quickly into a bird and plant walk. Birds spotted were – Pied Currawong, Large-Billed Scrub Wren, Eastern Yellow Robin, Lewin Honeyeater – a Bell Miner was heard in the distance. A few plants in view of the path were native Wisteria, Bolwarra tree and Acacias. Thanks to Erica Siegel's Bee talk at the AGM and with the keen eye of one of our group we able to recognise that the neat semicircular cuttings on the leaf of a native Ginger were not actually caused by a caterpillar or grasshopper, but in fact, the culprit was a Leaf Cutter Bee.

It was an enjoyable morning and culminated with a chat to exchange information as to what different members saw on the walk. A couple of Club members joined at this point as they had accessed the Circuit from the Café. Maybe, South D'Aguilar National Park could be visited again in the summer months. The area around the Walkabout Creek Discovery Centre is a worthwhile area to visit. Brochures are available from the Centre.

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Report of BOIC visit to Charles S Snow Environmental Reserve, Victoria Point, Redland City – *John T Moss*

This excursion was held on Saturday May 13th 2017, following the quarterly planning meeting held in "Mungara", the visitor centre and heritage museum run by the Friends of Eprapah Scout Fellowship.

Eprapah Environmental Education Centre, as it's generally known, is a 39 hectare bushland property in the heart of the Brisbane Bayside suburb of Victoria Point. It was partly used as a dairy farm when purchased by Scouting Australia (Qld Branch) in 1928. Scouting Queensland uses the property as a base for several Victoria Point Scout groups from Cubs upwards, and, in conjunction with the Qld Education Department, provides instructors and resources for "hands on" environmental education of primary school groups of children. The proximity of the tidal estuary of Eprapah Creek, which forms the northern boundary of the property, currently allows activities such as canoeing/kayaking. As a method of further funding for maintenance of the property, there are new plans for low impact recreational activities such as a tree-top ropes course on the southern perimeter adjacent to Colbourne Ave.

Due to the large area of bushland, including creek and estuarine riparian, the property is a remarkable refuge for wildlife, bird species in particular. In addition there are many species of crustacea, reptiles and fish in both the freshwater and tidal parts of the creek. There is considerable plant diversity, and, as would be expected, a plethora

of invertebrates including many species of dragon/damselflies, beetles, moths and butterflies.

It was because of the potential to augment the butterfly population that (about 13 years ago) the writer was asked to help design and plant up a dedicated butterfly garden on the south-eastern boundary of the property adjacent to the Cleveland-Redland Bay road (see "butterfly garden" on photo of property map). The "garden" area was marked out and a circuit path put in by a team of about a dozen young job aspirants in a Federal Government funded Green Corps team. Many of the applicable butterfly host plants were grown from seed in a nursery on site and some were supplied by the writer from his own nursery. Although the initial planting was mainly done over about 12 months, the whole process took three or four years of dedicated management (weeding, watering etc.) to ensure the plants were sufficiently established.

To encourage butterfly species that were uncommon in the Redlands, it was decided to include some native SEQ plants that were not normally found locally. Because of the hype at the time about bringing back the Richmond Birdwing to the Greater Brisbane area, it was decided to include its lowland host vine *Pararistolochia praevenosa* which several local people had already introduced to their gardens in the hope of encouraging passing female birdwings to oviposit. About this time in my own garden I had noticed female birdwings attracted to flowers (*Melicope* and *Melaleuca*) on two occasions and surmised that they could only have come from the closest known colony at Mt Tamborine, about 45km SSW as the "Common" Crow flies! A few years later I found a larva on one of my garden vines and about 5 years ago there was a report (with photos in the local paper) of an emergence of the butterfly from a vine in the garden of a Thornlands property not far from Eprapah.

Many of our more spectacular butterflies are hosted by native lianas and scramblers but understandably people are reluctant to plant vigorously growing vines in their gardens. I saw no such restrictions at Eprapah and introduced many vines into the planting. Among those were: *Trophis scandens* or Burny Vine, which hosts the stunning Purple Crow butterfly (*Euploea tulliolus*); *Callerya* (syn *Millettia*) *megasperma* or Native Wisteria, host for the Narrow-banded Awl (*Hasora khoda*) and Common Pencilled-blue (*Candalides absimilis*); *Melodorum leichhardtii* , Rauwenhoffia or Zig-Zag Vine, which hosts the delicate Four-barred Swordtail (*Protographium leosthenes*), Pale Triangle (*Graphium eurypylus*) and Common Red-eye (*Chaetocneme beata*). This last (clumsily renamed the Eastern Dusk-flat) is one of the group of large skippers known as "Flats" because they perch with all wings extended horizontally (usually upside-down on the underside of a leaf), fly at dusk and are rarely seen. I was first to record them using Rauwenhoffia when I found their shelters on the vine, whilst searching for Swordtail larvae in my garden. They are evidently at Eprapah as at least one spent shelter was seen on a laurel, as well as small

"leaf cut-outs", made by first or second instar larvae which had moved on or were taken by foraging wasps or Jumper Ants.

It was pleasing to show our group the amazing growth of all these vines which had ascended into the canopy and festooned many of the dead wattles and native cypress, bringing them back to life! As well there were many other interesting host trees and shrubs such as: Tulipwood (*Harpullia pendula*), host for the Bright Cornelian (*Deudorix diovis*) and at least four other lycaenid butterflies; Native Mulberry (*Pipturus argenteus*), host for the Jezebel Nymph (*Mynes geoffroyi*), Speckled Line-blue (*Catopyrops florinda*) and three others; Cluster Berry or Limeberry (*Micromelum minutum*) host for both Orchard and Fuscous Swallowtails; Pongamia (*Millettia pinnata*) host for the White-banded Plane (aka Common Aeroplane), Chrome and Narrow-banded Awls and at least three lycaenids.

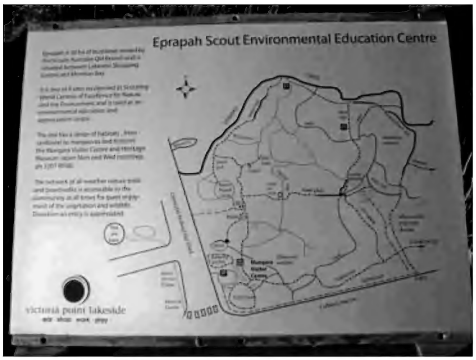
Also noted was a large *Senna sulfurea* (in the native *S. surattensis* group) which had fallen over but remained in full glorious flower. This had been part of a planting of cassias and sennas done to encourage the Lemon and Yellow Migrants to use the site, which duly succeeded. This senna seed Glenn Leiper, Peter Hendry and I had collected from a tree (containing Yellow Migrant larvae) on Mt Stradbroke in the Minden/Marburg range to the west.

Another aspect of the planting was to include plants (butterfly hosts and others) with different aromas, textures, leaf shapes etc. in a section called the Senses Loop. This was to show visitors (including the visually impaired) our botanical variety, and included plants such as Brachychitons, Lemon Scented Myrtle, Aniseed Myrtle, Bush Smell, Curry Leaf, Sandpaper Fig, Rough-leafed Elm and Native Hibiscus. Additionally within the plantings were a number of butterfly host plants which were considered to be good bush food. These included two species of Macadamia, two species of native limes, Peanut Tree (*Sterculia quadrifida*), and the aforementioned Rauwenhoffia or Zig-Zag Vine, which because of its tangy (sometimes) sherbert-flavoured fruit is also called "Acid Drop Vine".

Ironically, on the day of our visit in late autumn, butterflies on the wing were not evident in the densely planted up area visited. These were either high up in the canopy visiting the flowering eucalypts or were likely to be seen in sunny adjacent areas such as the Arboretum where nectar plants were more accessible.

I should also mention that the map of the scout property in the accompanying photo was produced by myself and fellow BOIC member Peter Hendry (utilising his professional talents and the club's old Garmin GPS unit) while we surveyed the area over many pleasant sunny days during one week in the early 2000's, not-with-standing ticks, Jumper Ants and (fever carrying) saltpan *Aedes vigilax* mosquitoes! Faded photocopies are given out to visitors at the Mungara hut, but there is more permanent testament to our efforts (with no credit given!) over the main road and adjacent to the lake near the Lakeside Restaurants at Victoria Point shopping centre,

where a (slightly vandalised) etched/anodised metal version stands alone.PS: The Friends of Eprapah Scout support group invite BOIC members who would like to visit the site to call in any time (daylight hours!) and self-guide themselves around the property at own risk. Alternatively I will be leading a Queensland Naturalists' Club visit to Eprapah on the weekend of 21/22 October next and BOIC are welcome to join (may be more butterflies in the spring!).



Pararistolochia praevenosa in flower
Photo Glenn Leiper

Rauwenhoffia or Acid Drop Vine (*Melodorum leichhardtii*) in fruit

Red-eye Flat (*Chaetocneme beata*) spent shelter on laurel

Peanut Tree (*Sterculia quadrifida*) in fruit

Photos, except where previously credited, John Moss

UNDER THE MICROSCOPE ANSWER

And the answer is …….*Ishiopsopha* sp., Mer Island, Torres Strait – body length 30mm

This, and previous image, Trevor Lambkin

YOU ASKED

Photo Rose Robin

Just wondering if you could identify this black caterpillar for me. It was in my backyard in Tamborine Mountain, Qld. Regards, Rose Robin

It is the larva of the Leaf Wing butterfly (*Doleschallia bisaltide*). *Ross*

Images of the adult and pupa Hongming Kan

OTHER GROUPS' ACTIVITIES

SGAP Spring Wildflower Show and Native Plants Market
When: 16th - 17th September 2017from 9am to 3pm
Where: Brisbane Botanic Gardens, Mount Coot-tha
What: The Spring Native Flower Show and Plants Market is a much anticipated yearly event. As well as the spectacular Spring Wildflower display, they will have a range of native plants for you to buy. Get some expert advice from the growers and learn something new at the Speaker's Corner. **BOIC will have a display at this event.**

Cubberla-Witton Catchwork Network Inc Pollinator Festival
When: Sunday 8th October 2017 from 10am to 2pm
Where: CWCN Centre, 47 Hepworth Street, Chapel Hill
What: A celebration of pollinators - bees, birds, bats, bugs, butterflies and moths. There will native plants, displays, speakers, music, face painting, trivia quiz, costume competition for kids, themed kids activities, crafts, food and refreshments. **BOIC will have a display at this event.**

Rick Natrass Environmental Park, Goodna
When: **10am 21st October 2017**
Where: 82 Eric Street, Goodna
What you may expect to see: Imperial Hairstreak, other butterflies, large variety of host plants and so many bugs to see you will go bug eyed yourself.
What to bring: Hat, water, insect repellant, lunch, camera, good walking shoes
RSVP: Phone Paul Klicin on 0411 031 406 or email paulez2@hotmail.com

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Planning and General Meeting
What: Our quarterly planning meetings are informative and interesting and we welcome members to contribute to discussion. This meeting will be followed by a tour of the EcoCentre facilities and a walk in the bush nearby (part of Toohey Forest).
When: 10am Saturday 11th November 2017
Where: The Eco Centre, Griffith University campus. Parking is plentiful and free.
What to bring: Enthusiasm is welcome**.** Tea, coffee and biscuits will be provided.

Pooh Corner (Western end) Wacol
When: **10am 18th November 2017**
Where: Wacol Station Road (runs past Prison). Look for the Pooh Corner sign. Park on roadside.
What you may expect to see: Clearing Swallowtail, Lesser Wanderer, Blue Triangle, Joseph's Coat Moth lavae and other butterflies and bugs and host plants.
What to bring: Hat, water, insect repellant, lunch, camera, good walking shoes
RSVP: Phone Paul Klicin on 0411 031 406 or email him at paulez2@hotmail.com

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Springbrook National Park Revisited
When: 10am 2nd December 2017
Where: Following significant damage from ex-Tropical Cyclone Debbie, Gold Coast-Springbrook Road from Mudgeeraba remains closed until further notice. Access to Springbrook National Park is via Numimbah Valley along Pine Creek Road only. Please contact Paul closer to the date to check on road conditions.
Meet at: Tallabana picnic area which is near Canyon Lookout off Canyon Parade.
Amenities: Toilets, picnic tables
What you may expect to see: Richmond Birdwing, Land Mullet, awesome rock formations and waterfalls.
What to bring: Hat, water, insect repellant, lunch, camera, good walking shoes
RSVP: Phone Paul Klicin on 0411 031 406 or email him at paulez2@hotmail.com

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DISCLAIMER

The magazine seeks to be as scientifically accurate as possible but the views, opinions, and observations expressed are those of the authors. The magazine is a platform for people, both amateur and professional, to express their views and observations about invertebrates. These are not necessarily those of the BOIC. The manuscripts are submitted for comment to entomologists or people working in the area of the topic being discussed. If inaccuracies have inadvertently occurred and are brought to our attention we will seek to correct them in future editions. The Editor reserves the right to refuse to print any matter which is unsuitable, inappropriate or objectionable and to make nomenclature changes as appropriate.

ACKNOWLEDGMENTS

Producing this magazine is done with the efforts of:

- Those members who have sent in letters and articles
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- Kelvyn Dunn, Ross Kendall, Richard Zietek, John Moss and Ted Edwards for scientific referencing and proof-reading of various articles in this issue of the magazine

ARE YOU A MEMBER?

Please check your mailing label for the date your membership is due for renewal. If your membership is due, please renew as soon as possible. **Annual membership fees are $30.00 for individuals, schools, and organizations**. If you wish to pay electronically, the following information will assist you: BSB: **484-799**, Account No: **001227191**, Account name: **BOIC**, Bank: **Suncorp**, Reference: your membership number and surname e.g. **234 Roberts.**

Butterfly and Other Invertebrates Club Inc.
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RUNCORN Q. 4113

Next Club event: Rick Natrass Environmental Park, Goodna –21st October 2017